Narrower Residential Streets

Postconstruction Storm Water Management in New Development and Redevelopment

Description

A narrow street in a residential neighborhood. Cars can be parked in driveways or along the road shoulder

This better site design practice promotes the use of narrower streets to reduce the amount of impervious cover created by new residential development and, in turn, reduce the storm water runoff and associated pollutant loads. Currently, many communities require wide residential streets that are 32, 36, and even 40 feet wide. These wide streets provide two parking lanes and two moving lanes, but provide much more parking than is actually necessary. In many residential settings, streets can be as narrow as 22 to 26 feet wide without sacrificing emergency access, on-street parking or vehicular and pedestrian safety. Even narrower access streets or shared driveways can be used when only a handful of homes need to be served. However, developers often have little flexibility to design narrower streets, as most communities require wide residential streets as a standard element of their local road and zoning standards. Revisions to current local road standards are often needed to promote more widespread use of narrower residential streets.

Applicability

Narrower streets can be used in residential development settings that generate 500 or fewer average daily trips (ADT), which is generally about 50 single family homes, and may sometimes also be feasible for streets that are projected to have 500 to 1,000 ADT. However, narrower streets are not feasible for arterials, collectors, and other street types that carry greater traffic volumes or are not expected to have a constant traffic volume over time.

In most communities, existing local road standards will need to be modified to permit the use of narrower streets. Several communities have successfully implemented narrower streets, including Portland, OR; Bucks County, PA; Boulder, CO; and throughout New Jersey. In addition, there are numerous examples of communities where developers have successfully narrowed private streets within innovative subdivisions.

Siting and Design Conditions

Residential street design requires a careful balancing of many competing objectives: design, speed, traffic volume, emergency access, parking, and safety. Communities that want to change their road standards to permit narrower streets need to involve all the stakeholders who influence street design in the revision process. Several excellent references on narrow street design are provided at the end of this fact sheet.

Limitations

A number of real and perceived barriers hinder wider acceptance of narrower streets at the local level. Advocates for narrower streets will need to respond to the concerns of many local agencies and the general public. Some of the more frequent concerns about narrower streets are listed below.

- *Inadequate On-Street Parking*. Recent research and local experience have demonstrated that narrow streets can easily accommodate residential parking demand. A single family home typically requires 2 to 2.5 parking spaces. In most residential zones, this parking demand can be easily satisfied by one parking lane on the street and driveways.

- *Car and Pedestrian Safety*. Recent research indicates that narrow streets have lower accident rates than wide streets. Narrow streets tend to lower the speed of vehicles and act as traffic calming devices.

- *Emergency Access.* When designed properly, narrower streets can easily accommodate fire trucks, ambulances and other emergency vehicles.

- *Large Vehicles.* Field tests have shown that school buses, garbage trucks, moving vans, and other large vehicles can generally safely negotiate narrower streets, even when cars are parked on both sides of the street. In regions with high snowfall, streets may need to be slightly wider to accommodate snowplows and other equipment.

- *Utility Corridors*. It is often necessary to place utilities underneath the street rather than in the right of way.

In addition, local communities may lack the authority to change road standards when the review of public roads is retained by state agencies. In these cases, street narrowing can be accomplished only on private streets (i.e., maintained by residents rather than a local or state agency).

Maintenance Considerations

Narrower streets should slightly reduce road maintenance costs for local communities, since they present a smaller surface area to maintain and repair.

Effectiveness

Since streets constitute the largest share of impervious cover in residential developments (about 40 to 50 percent), a shift to narrower streets can result in a 5-to 20-percent overall reduction in impervious area for a typical residential subdivision (Schueler, 1995). As nearly all the pollutants deposited on street surfaces or trapped along curbs are delivered to the storm drain system during storm events, this reduced imperviousness translates directly into less storm water runoff and pollutant loadings from the development. From the standpoint of storm water quality, residential streets rank as a major source area for many storm water pollutants, including sediment, bacteria, nutrients, hydrocarbons, and metals (Bannerman, 1994).

Cost Considerations

Narrower streets cost less to build than wider streets. Considering that the cost of paving a road averages $15 per square yard, shaving even a mere four feet from existing street widths can yield cost savings of more than $35,000 per mile of residential street. In addition, since narrower streets produce less impervious cover and runoff, additional savings can be realized in the reduced size and cost of downstream storm water management facilities.

References

Bannerman, R. 1994. *Sources of Pollutants in Wisconsin Stormwater*. Wisconsin Dept. of Natural Resources. Milwaukee, WI.

Schueler, T.R. 1995. *Site Planning for Urban Stream Protection*. Center for Watershed Protection, Ellicott City, MD.

Information Resources

American Association of State Highway and Transportation Officials (AASHTO). 1994. *A Policy on Geometric Design of Highways and Streets*. AASHTO Publications, Washington, DC.

Bucks County Planning Commission. 1980. *Performance Streets: A Concept and Model Standards for Residential Streets*. Doylestown, PA.

Center for Watershed Protection (CWP). 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Ellicott City, MD.

Ewing, R. 1996. *Best Development Practices: Doing the Right Thing and Making Money at the Same Time.* American Planning Association, Planners Book Service. Chicago, IL.

Institute of Traffic Engineers. 1997. *Traditional Neighborhood Development Street Design Guidelines*. Washington, DC.

Portland Office of Transportation. 1994. *Report on New Standards for Residential Streets in Portland, Oregon*. City of Portland, Portland, OR.

Urban Land Institute. *Residential Streets.* 2d ed. Washington, DC.

Eliminating Curbs and Gutters

Postconstruction Storm Water Management in New Development and Redevelopment

Description

Developers can eliminate curbs and gutters to disconnect impervious surfaces and promote infiltration of storm water on vegetated areas (such as this grass-lined channel in a residential neighborhood)

This better site design practice involves promoting the use of grass swales as an alternative to curbs and gutters along residential streets. Curbs and gutters are designed to quickly convey runoff from the street to the storm drain and, ultimately, to the local receiving water. Consequently, curbs and gutters provide little or no removal of storm water pollutants. Indeed, curbs often act as a pollutant trap where deposited pollutants are stored until they are washed out in the next storm. Many communities require curb and gutters as a standard element of their road sections, and discourage the use of grass swales. Revisions to current local road and drainage regulations are needed to promote greater use of grass swales along residential streets, in the appropriate setting. The storm water management and pollutant removal benefits of grass swales are documented in detail in the Grassed Swales fact sheet.

Applicability

The use of engineered swales in place of curbs and gutters should be encouraged in low- and medium-density residential zones where soils, slope and housing density permit. However, eliminating curbs and gutters is generally not feasible for streets with high traffic volume or extensive on-street parking demand (i.e., commercial and industrial roads), nor is it a viable option in arid and semi-arid climates where grass cannot grow without irrigation. Moreover, the use of grass swales may not be permitted by current local or state street and drainage standards.

Siting and Design Conditions

A series of site factors must be evaluated to determine whether a grass swale is a viable replacement for curbs and gutters at a particular site.

Contributing drainage area. Most individual swales cannot accept runoff from more than 5 acres of contributing drainage area, and typically serve 1–2 acres each.

Slope. Swales generally require a minimum slope of 1 percent and a maximum slope of 5 percent.

Soils. The effectiveness of swales is greatest when the underlying soils are permeable (hydrologic soil groups A and B). The swale may need more engineering if soils are less permeable.

Water Table. Swales should be avoided if the seasonally high water table is within 2 feet of the proposed bottom of the swale.

Development Density. The use of swales is often difficult when development density becomes more intense than four dwelling units per acre, simply because the number of driveway culverts increases to the point where the swale essentially becomes a broken-pipe system. Typically, grass swales are designed with a capacity to handle the peak flow rate from a 10-year storm, and fall below erosive velocities for a 2-year storm.

Limitations

A number of real and perceived limitations hinder the use of grass swales as an alternative to curb and gutters:

- *Snowplow operation can be more difficult without a defined road edge*. However, on the plus side, roadside swales increase snow storage at the road edge, and smaller snowplows may be adequate.

- *The pavement edge along the swale can experience more cracking and structural failure, increasing maintenance costs.* The potential for pavement failure at the road/grass interface can be alleviated by "hardening" the interface with grass pavers or geo-synthetics placed beneath the grass. Other options include placing a low-rising concrete strip along the pavement edge.

- *The shoulder and open channel will require more maintenance*. In reality, maintenance requirements for grass channels are generally comparable to those of curb and gutter systems. The major requirements involve turf mowing, debris removal, and periodic inspections.

- *Some grass swales can have standing water, which make them difficult to mow, and can cause nuisance problems such as odors, discoloration, and mosquitoes*. In reality, grass channels are not designed to retain water for any appreciable period of time, and the potential for snakes and other vermin can be minimized by frequent mowing.

Other concerns involve fears about utility installation and worries that the grass edge along the pavement will be torn up by traffic and parking. While utilities will need to be installed below the paved road surface instead of the right of way, most other concerns can frequently be alleviated through the careful design and integration of the open channels along the residential street. (Consult the Grassed Swales fact sheet for details on design variations that can reduce these problems.)

Maintenance Considerations

The major maintenance requirement for grass swales involves mowing during the growing season, a task usually performed by homeowners. In addition, sediment deposits may need to be removed from the bottom of the swale every ten years or so, and the swale may need to be tilled and re-seeded periodically. Occasionally, erosion of swale side slopes may need to be stabilized. The overall maintenance burden of grass swales is low in relation to other storm water practices, and is usually within the competence of the individual homeowner. The only major maintenance problem that might arise pertains to "problem" swales that have standing water and are too wet to mow. This particular problem is often alleviated by the installation of an underground storm drain system.

Effectiveness

Under the proper design conditions, grass swales can be effective in removing pollutants from urban storm water (Schueler, 1996). More information on the pollutant removal capability of various grass swale designs can be found in the Grassed Swales fact sheet.

Cost Considerations

Engineered swales are a much less expensive option for storm water conveyance than the curb and gutter systems they replace. Curbs and gutters and the associated underground storm sewers frequently cost as much as $36 per linear foot, which is roughly twice the cost of a grass swale (Schueler, 1995, and CWP, 1998). Consequently, when curbs and gutters can be eliminated, the cost savings can be considerable.

References

Center for Watershed Protection (CWP). 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection, Ellicott City, MD.

Schueler, T.R. 1995. *Site Planning for Urban Stream Protection*. Metropolitan Washington Council of Governments. Washington, DC.

Schueler, T.R. 1996. "Ditches or Biological Filters? Classifying the Pollutant Removal Performance of Open Channels." *Watershed Protection Techniques* 2(2) pp. 379–83.

Information Resources

Claytor, R.A., and T.R. Schueler. 1997. *Design of Stormwater Filtering Systems*. Center for Watershed Protection, Ellicott City, MD.

Green Parking

Postconstruction Storm Water Management in New Development and Redevelopment

Description

A green parking lot at the Orange Bowl in Miami, Florida (Source: Invisible Structures, no date)

Green parking refers to several techniques applied together to reduce the contribution of parking lots to the total impervious cover in a lot. From a storm water perspective, application of green parking techniques in the right combination can dramatically reduce impervious cover and, consequently, the amount of storm water runoff. Green parking lot techniques include setting maximums for the number of parking lots created, minimizing the dimensions of parking lot spaces, utilizing alternative pavers in overflow parking areas, using bioretention areas to treat storm water, encouraging shared parking, and providing economic incentives for structured parking.

Applicability

All of the green parking techniques can be applied in new developments and some can be applied in redevelopment projects, depending on the extent and parameters of the project. In urban areas, application of some techniques, like encouraging shared parking and providing economic incentives for structured parking, can be very practical and necessary. Commercial areas can have excessively high parking ratios, and application of green parking techniques in various combinations can dramatically reduce the impervious cover of a site.

Implementation

Many parking lot designs result in far more spaces than actually required. This problem is exacerbated by a common practice of setting parking ratios to accommodate the highest hourly parking during the peak season. By determining average parking demand instead, a lower maximum number of parking spaces can be set to accommodate most of the demand. Table 1 provides examples of conventional parking requirements and compares them to average parking demand.

Table 1: Conventional minimum parking ratios (Source: ITE, 1987; Smith, 1984; Wells, 1994)

Land Use	Parking Requirement		Actual Average Parking Demand
	Parking Ratio	Typical Range	
Single family homes	2 spaces per dwelling unit	1.5–2.5	1.11 spaces per dwelling unit
Shopping center	5 spaces per 1000 ft^2 GFA	4.0–6.5	3.97 per 1000 ft^2 GFA
Convenience store	3.3 spaces per 1000 ft^2 GFA	2.0–10.0	--
Industrial	1 space per 1000 ft^2 GFA	0.5–2.0	1.48 per 1000 ft^2 GFA
Medical/ dental office	5.7 spaces per 1000 ft^2 GFA	4.5–10.0	4.11 per 1000 ft^2 GFA
GFA = Gross floor area of a building without storage or utility spaces.			

Another green parking lot technique is to minimize the dimensions of the parking spaces. This can be accomplished by reducing both the length and width of the parking stall. Parking stall dimensions can be further reduced if compact spaces are provided. While the trend toward larger sport utility vehicles (SUVs) is often cited as a barrier to implementing stall minimization technique, stall width requirements in most local parking codes are much larger than the widest SUVs (CWP, 1998).

Utilizing alternative pavers is also an effective green parking technique. They can replace conventional asphalt or concrete in both new developments and redevelopment projects. Alternative pavers can range from medium to relatively high effectiveness in meeting storm water quality goals. The different types of alternative pavers include gravel, cobbles, wood mulch, brick, grass pavers, turf blocks, natural stone, pervious concrete, and porous asphalt. In general, alternate pavers require proper installation and more maintenance than conventional asphalt or concrete. For more specific information on alternate pavers, refer to the Alternative Pavers fact sheet.

Bioretention areas can effectively treat storm water leaving a parking lot. Storm water is directed into a shallow, landscaped area and temporarily detained. The runoff then filters down through the bed of the facility and is infiltrated into the subsurface or collected into an underdrain pipe for discharge into a stream or another storm water facility. Bioretention facilities can be attractively integrated into landscaped areas and can be maintained by commercial landscaping firms. For detailed design specifications of bioretention areas, refer to the Bioretention fact sheet.

Shared parking in mixed-use areas and structured parking also are green parking techniques that can further reduce the conversion of land to impervious cover. A shared parking arrangement could include usage of the same parking lot by an office space that experiences peak parking demand during the weekday with a church that experiences parking demands during the weekends and evenings. Costs may dictate the usage of structured parking, but building upward or downward can help minimize surface parking.

Limitations

Some limitations to applying green parking techniques include applicability, cost, and maintenance. For example, shared parking is only practical in mixed use areas, and structured parking may be limited by the cost of land versus construction. Alternative pavers are currently only recommended for overflow parking because of the considerable cost of maintenance. Bioretention areas increase construction costs.

The pressure to provide excessive parking spaces can come from fear of complaints as well as requirements of bank loans. These factors can pressure developers to construct more parking than necessary and present possible barriers to providing the greenest parking lot possible.

Effectiveness

Applied together, green parking techniques can effectively reduce the amount of impervious cover, help to protect local streams, result in storm water management cost savings, and visually enhance a site. Proper design of bioretention areas can help meet storm water management and landscaping requirements while keeping maintenance costs at a minimum.

Utilizing green parking lots can dramatically reduce the amount of impervious cover created. The level of the effectiveness depends on how much impervious cover is reduced as well as the combination of techniques utilized to provide the greenest parking lot. While the pollutant removal rates of bioretention areas have not been directly measured, their capability is considered comparable to a dry swale, which removes 91 percent of total suspended solids, 67 percent of total phosphorous, 92 percent of total nitrogen, and 80–90 percent of metals (Claytor and Schueler, 1996).

An excellent example of the multiple benefits of rethinking parking lot design is the Fort Bragg vehicle maintenance facility parking lot in North Carolina (NRDC, 1999). This redesign reduced impervious cover by 40 percent, increased parking by 20 percent, and saved $1.6 million (20 percent) on construction costs over the original, conventional design. Stormwater management features, such as detention basins located within grassed islands and an onsite drainage system that took advantage of existing sandy soils, were incorporated into the parking lot design as well.

Cost Considerations

Setting maximums for parking spaces, minimizing stall dimensions, and encouraging shared parking can result in considerable construction cost savings. At the same time, implementing green parking techniques can also reduce storm water management costs.

References

Center for Watershed Protection. 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection, Ellicott City, MD.

Claytor, R.A., and T.R. Schueler. 1996. *Design of Stormwater Filtering Systems*. Center for Watershed Protection, Inc., Ellicott City, MD.

Invisible Structures. No date. Aerial view of east parking lot just after installation. [http://www.invisiblestructures.com/Project%20Profiles/Grasspave/Orange%20Bowl/Stadium.jpg]. Accessed May 22, 2001.

ITE. 1987. *Parking Generation*, 2nd edition. Institute of Transportation Engineers, Washington, DC.

Natural Resources Defense Council (NRDC). 1999. *Stormwater Strategies: Community Responses to Runoff Pollution*. Natural Resources Defense Council, Washington, DC.

Smith, T. 1984. *Flexible Parking Requirements*. Planning Advisory Service Report No. 377. American Planning Association, Chicago, IL.

Wells, C. 1994. *Impervious Surface Reduction Technical Study*. Draft Report. City of Olympia Public Works Department. Washington Department of Ecology, Olympia, WA.

Information Resources

Bergman, D. 1991. *Off-Street Parking Requirements*. American Planning Association, Chicago, IL.

Brown, W.E., D.S. Caraco, R.A. Claytor, P.M. Hinkle, H.Y. Kwon, and T.R. Schueler. 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Center for Watershed Protection, Inc., Ellicott City, MD.

Brown, W.E., and T.R. Schueler. 1996. *The Economics of Stormwater BMPs in the Mid-Atlantic Region: Final Report*. Center for Watershed Protection, Ellicott City, MD.

Diniz, E. 1993. *Hydrologic and Water Quality Comparisons of Runoff from Porous and Conventional Pavements*. CRC Press, Lewis Publishers, Boca Raton, FL.

Morris, M. 1989. *Parking Standards—Problems, Solutions, Examples*. PAS Memo, December 1989 issue. American Society of Planning Officials, Chicago, IL.

Smith, D.R. 1981. *Life Cycle and Energy Comparison of Grass Pavement and Asphalt Based on Data and Experience from the Green Parking Lot*. The Heritage Conservation and Recreation Service, Washington, DC.

Smith, D.R., and D.A. Sholtis. 1981. *An Experimental Installation of Grass Pavement*. The Heritage Conservation and Recreation Service, Washington, DC.